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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

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☐ *Additional inventors are being named on the____ separately numbered sheets attached hereto*

TITLE OF THE INVENTION (280 characters max)

COMMUNICATING SIGNAL PROCESSING CAPABILITIES IN A COMMUNICATIONS PATH

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ENCLOSED APPLICATION PARTS *(check all that apply)*

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☒ A check or money order is enclosed to cover the filing fees

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☐ Payment by credit card. Form PTO-2038 is attached.

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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No.

☐ Yes, the name of the U.S. Government agency and the Government contract number are: _____

Respectfully submitted,

SIGNATURE

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Date 03/19/2004

REGISTRATION NO. *(if appropriate)* 40,025

Docket Number: NRF.0005L1US

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

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PROVISIONAL PATENT APPLICATION

TITLE: **COMMUNICATING SIGNAL PROCESSING CAPABILITIES IN A COMMUNICATIONS PATH**

INVENTOR(S): **CHUNG CHEUNG CHU,**

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COMMUNICATING SIGNAL PROCESSING CAPABILITIES IN A COMMUNICATIONS PATH

Introduction:

This document captures the design of a communication protocol for bearer signal processing capability coordination and control. This document also presents rules to be followed by communication nodes to enable and disable capabilities based on the information exchanged by the protocol.

Background:

Signal processing features for voice quality (VQ) enhancement could be present in different communication nodes and mixed in different ways on the bearer path between end users. This presents challenges in the proper coordination of the features. For example, as the presence and use of media gateways (MGs) become common, certain features could be supported and executed by different MGs on the same path. Typically, feature tandeming introduces subjective degradation. Another concern is that the features are supported but not enabled by the nodes, resulting in no enhancement. Another concern is that a node may dynamically enable or disable the support of a feature as a result of changes to local requirements or constraints. All these concerns require the communication nodes to be properly controlled and coordinated to provide the communication with the optimal set of signal processing functions. Communication nodes can be such as media gateways, base station equipments and end-point equipments.

Requirements:

The following is a list of requirements of the protocol for end-to-end VQ coordinations. It is noted that the protocol can be extended to support other types of signal processing capabilities such as those for video communication.

- Capability announcement: Need to broadcast/unicast own capability to other nodes
- Capability identification: Need to find out what other nodes can and cannot do
- Overlapped capability resolution: Need to resolve conflict when multiple nodes support the same capability

- Call topology change: Need to maintain and update the information and coordination effectively and efficiently in response to topology, i.e. system level, change
- Dynamic capability change: Need to maintain and update the information and coordination effectively and efficiently in response to node, i.e. local, capability change

Protocol:

The text below describes a protocol for communication node capability information exchange and coordination.

Assumptions

- An exhaustive list of features is agreed to by all communication nodes. A node may or may not support the features in the list, however.
- Need a signaling channel. The signaling channel can be defined on an existing payload structure with pre-defined synchronization information, for example UMTS Iu and Nb PDUs, or on traffic without pre-defined synchronization information, for example PCM samples.
- Signaling can be done out-of-band or in-band.
- A node can individually define the capability dynamically. Feature support decision is made individually by each node by applying a set of pre-defined rules shared by all nodes to the information received.
- All nodes capable of providing a feature in the list and placed in the bearer path must comply with the protocol. Communication nodes placed in the bearer path may not be capable of providing the features. However, communication nodes capable of providing the features cannot refuse to disable a feature which is to be enabled by another node according to the protocol.

Procedure

The following describes a simple protocol design. Without loss of generality, the procedure is illustrated with a set of media gateways below for features applied in the direction from left to right. The procedure for features applied in the other direction is implied. Also, even though illustrated with media gateways, note that other entities, such as terminals (e.g., mobile handsets, landline handsets) and nodes (e.g., base stations) can also participate in the procedure of communicating features.

In the example below, bearer traffic flows in the direction from MG1 to MG2 to MGn. Each MG is capable of a set of features, such as signal processing features. Signal

processing features include audio signal processing features, video signal processing features, and so forth. Each MG posts its feature capability in the common feature list. This list is to be defined to cover all possible features supported by all MGs. Capability posting for features is done in both directions. The capabilities posted are OR'ed in the list as it flows through the MGs. This is to inform MGs before and after of the features applicable to traffic flow in the direction from left to right.

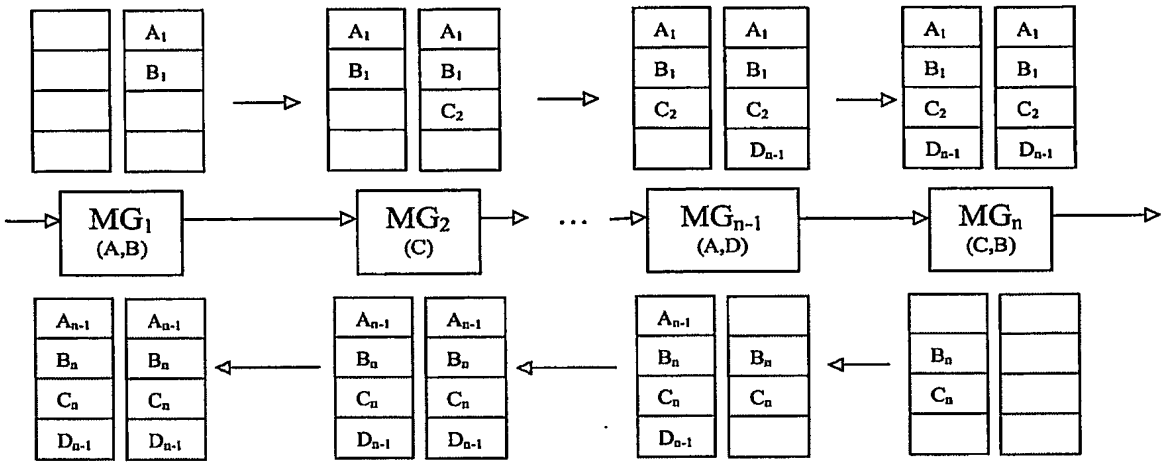
A posting marks the capabilities available in the list and supported by the MG. Each posting also contains a set of attributes characteristic of the MG and the feature. Attributes include the followings:

- level of commitment to reflect local DSP resource availability and constraint
- I/O characteristics as a function of the delay jitter and packet loss rate

In this example, the list shown above the MGs is sent to MGs on the downstream of the traffic flow. The list below the MGs is sent to MGs on the upstream of the traffic flow. This protocol allows

- A MG to realize if it is the first one in the chain capable of providing the feature or if there is another MG on the upstream capable of providing the feature.
- A MG to realize if it is the last one in the chain capable of providing the feature or if there is another MG on the downstream capable of providing the feature.
- A MG to individually make decision as to enable or disable the internal feature based on the knowledge of other MGs on the path.
- A MG to update its capability dynamically for example in light of MG load change, system configuration change (e.g. handover, conferencing), and so forth.
- No confirmation or acknowledgement exchanges between MGs to determine which MG should activate which features.

The capability list can be added in the case of 3GPP to the Iu or Nb PDU packet and sent with the bearer traffic in-band. It can also be sent out-of-band or in TFO frames and messages on TDM connections.



Interpretations

In the figure above, we have

- MG_2 knows it is the first MG supporting feature C
- MG_2 knows there is another MG downstream supporting feature C
- MG_2 learns availability and constraints of MG_n in supporting feature C from the attributes associated with the broadcast by MG_n
- MG_2 looks up to the rule-set with the information local to MG_2 itself and local to MG_n to determine if it should activate feature C
- MG_n knows there is a MG upstream capable of supporting feature C
- MG_n learns availability and constraints of MG_2 in supporting feature C from the attributes associated with the broadcast by MG_2
- MG_n looks up to the rule-set with the information local to MG_n itself and local to MG_2 to determine if it should activate feature C

Rules for Feature Control:

The tables below are examples of rules defined for a set of example voice quality enhancement features. The example features include echo cancellation (EC), acoustic echo control (AEC), background noise reduction (NR), and automatic level control (ALC). The tables tabulate the preferred locations where a feature should be activated

when multiple nodes on the same traffic path offer the same capability. IP phones include personal computers (PC) and personal data assistance (PDA) devices, which can be readily downloaded with programs performing the voice enhancement features. Without loss of generality, the preferences are defined based on the assumption that traffic flows in the direction from left to right.

It is also noted that the tables can be further enhanced to incorporate attribute information such as level of commitments and node constraints. The enhancement would result in a set of rules better reflecting the end-to-end connection requirements and conditions.

In the tables, the term "Disable" indicates that a particular feature is to be disabled in the corresponding node. The term "Low Preference" indicates that there is low preference in enabling the particular feature in the corresponding node. The term "Medium" indicates that there is medium preference in enabling the particular feature in the corresponding node. The term "High Preference" indicates that there is high preference is enabling the particular feature.

For example, in the first section of the table below, a rule set for the echo cancellation (EC) feature is defined among the originating node, transit node, and terminating node. In a call between a mobile terminal and another mobile terminal, the EC feature is disabled in each of the originating, transit, and terminating nodes.

However, in a call between a mobile terminal and a POTS terminal, the EC feature is enabled in one or more of the originating, transit, and terminating nodes. As indicated by the "High Preference" term, it is more preferably to enable the EC feature in the terminating node than in either of the originating node ("Low Preference") or the transit node ("Medium").

The rules defined by the tables below are provided for the purpose of example. Other rules can be defined in other implementations. Mechanisms according to some embodiments of the invention are used to address the feature coordination concerns for core network designs that have include multiple gateways or other nodes that are capable of differing signal processing capabilities. The mechanisms can be used in both wireline and wireless products, such as GSM, UMTS and CDMA2000. The mechanisms discussed above provide an inter-node communication protocol for feature capability

coordination and control. The mechanisms also define rules to be followed by the nodes, such as media gateways and other nodes or terminals, to enable and disable feature capabilities based on information exchanged by the inter-node communication protocol.

Voice Enhancement features	*End-point device*	*Originating Node*	*Transit Nodes*	*Terminating Node*	*End-point device*
Acoustic Echo					
		EC least preferred location AEC preferred location		EC preferred location AEC least preferred location	Hybrid Echo
EC	Mobile	Disable	Disable	Disable	Mobile
		Disable	Disable	Disable	IP phone
		Low Preference	Medium	High Preference	POTS
	IP Phone	Disable	Disable	Disable	Mobile
		Disable	Disable	Disable	IP phone
		Low Preference	Medium	High Preference	POTS
	POTS	Disable	Disable	Disable	Mobile
		Disable	Disable	Disable	IP phone
		Low Preference	Medium	High Preference	POTS
AEC	Mobile [1]	High Preference	Medium	Low Preference	Mobile
		High Preference	Medium	Low Preference	IP phone
		High preference	Medium	Low Preference	POTS
	IP Phone [2]	High Preference	Medium	Low Preference	Mobile
		High Preference	Medium	Low Preference	IP phone
		High Preference	Medium	Low Preference	POTS
	POTS	Disable	Disable	Disable	Mobile
		Disable	Disable	Disable	IP phone
		Disable	Disable	Disable	POTS

1. Some mobiles may be equipped with acoustic echo control. In this case, AEC may be deactivated in the network nodes.
2. Some IP phones may be downloaded with 3rd party software to perform AEC. In this case, AEC may be turned off in the network nodes.

Voice Enhancement features	*End-point device*	*Originating Node*	*Transit Nodes*	*Terminating Node*	*End-point device*
NR	Mobile [1]	No Preference	No Preference	No Preference	Mobile
		No Preference	No Preference	No Preference	IP phone
		High Preference [3]	Medium	Low Preference	POTS
	IP Phone [2]	No Preference	No Preference	No Preference	Mobile
		No Preference	No Preference	No Preference	IP phone
		High Preference [3]	Medium	Low Preference	POTS
	POTS	No Preference	No Preference	No Preference	Mobile
		No Preference	No Preference	No Preference	IP phone
		High Preference [3]	Medium	Low Preference	POTS
ALC	Mobile	No Preference	No Preference	No Preference	Mobile
		No Preference	No Preference	No Preference	IP phone
		High Preference [3]	No Preference	Low Preference	POTS
	IP Phone [2]	No Preference	No Preference	No Preference	Mobile
		No Preference	No Preference	No Preference	IP phone
		High Preference [3]	Medium	Low Preference	POTS
	POTS	No Preference	No Preference	No Preference	Mobile
		No Preference	No Preference	No Preference	IP phone
		High Preference [3]	Medium	Low Preference	POTS

1. Depending on the codec used, some standards, e.g., ANSI-127, IS-893 used in CDMA 2000®, have built-in noise reduction. In this case, NR may be turned off in the network nodes.
2. Some smart IP phones can be downloaded with 3rd party software to perform ALC as well as NR. In this case, ALC and NR may be turned off in the network nodes.
3. Both ALC and NR must be applied prior to the R_{in} and after the S_{out} of the echo canceller if EC is on the signal path.

Question(s):	8	**Meeting, date:**	Geneva, 19-30 April 2004
Study Group:	15 **Working Party:** 2	**Intended type of document** (R-C-D-TD):	D
Source:	Nortel Networks (Canada)		
Title:	Some Requirements for a Mechanism to Coordinate SPNE in a Communication Link to Improve Voice Quality		

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Abstract: This contribution presents some requirements for a mechanism to facilitate the control of SPNE in a communication link.

I. Introduction

With the advance in telecommunications, signal processing features for voice quality (VQ) enhancement could be found in different communication nodes and mixed in different ways on a bearer path. However, instead of the intended enhancements, signal processing enhancement functions deployed on the same bearer path could have end-to-end voice quality degradation due to interactions of the individual enhancement functions. G.161 has captured and presented interaction considerations for some Signal Processing Network Equipments (SPNE) [1]. Reference [2] also attempted to present information on the preferred locations of certain signal processing functions in a communication connection.

SPNE interaction concerns require the communication nodes to be properly coordinated and controlled to provide the end-to-end communication with the optimal placement of signal processing functions. While some equipment is under the direct control of the local operators, some equipment for example in an inter-system connection is not

controllable. It is also appreciated that SPNE deployed by the same operators in a local network may not easily be coordinated. Failure in the SPNE coordination and control results in potential voice quality degradation suggested by [1].

The objective of this contribution is to discuss the need for a coordinated approach to address the SPNE interaction concerns for end-to-end voice quality enhancement realization.

II. Discussion

SPNEs are typically deployed locally to function in a standalone manner to provide voice quality enhancement. However, interaction of the functions on the bearer path can have adverse voice quality impacts. As presented by G.161, there are many different types of voice enhancement functions, and there are many different levels of voice quality impact due to the interactions of these functions. Interactions can be between equipments of same functional capabilities, such as Automatic Level Control. Interactions can be between equipments of different functional capabilities such as Hybrid and Acoustic Echo Cancellation.

Control of the SPNEs can be carried out individually with separate control mechanism. However individually defined mechanisms for specific types of signal processing enhancement functions have the following shortcomings:

1 Incapable of addressing interactions among signal processing functions of different types,
2 Complication in maintenances and coherent updates of individually defined mechanisms,
3 Inefficiency in design realization/implementation due to possibly incompatible and incoherent design principles

In view of the concerns above, it is suggested that a single unified mechanism should be considered and defined to coordinate the standalone voice quality enhancement equipments/functions. The mechanism coordinates the preferred location selection and activation/de-activation of the SPNEs supported. It will ensure delivery of end-to-end

voice quality enhancement. The following is a list of suggested requirements of a mechanism for coordinated SPNE control.

- **Capability announcement**: Support broadcast of signal processing enhancement capabilities by a communication node to other communication nodes.
- **Capability identification**: Support identification of signal processing enhancement capabilities by a communication node of other communication nodes.
- **Overlapped capability resolution**: Provide resolution of conflicts and adverse interactions among signal processing functions based on the capability information exchanged.
- **Call topology change**: Support maintenance/update of coordination effectively and efficiently in response to dynamic system level change such as due to call transfers.
- **Local capability change**: Support maintenance/update of coordination effectively and efficiently in response to dynamic communication node capability change.

III. Conclusion

This contribution recommends the definition of a coordinated mechanism to properly address interactions of SPNEs present on bearer paths of communication systems.

References

1. ITU-T Recommendation G.161, "Interaction aspects of signal processing network equipment", 2004_VI.
2. CANCOM15-109, "Considerations on the Preferred Locations of Different SPNE in a Communication Link to Achieve Better Voice Quality", October 21-31, 2003.

What is claimed is:

1. A method of coordinating signal processing capabilities among plural nodes, comprising:

receiving, at a first node, a data structure containing one or more elements indicating one or more signal processing capabilities of a second node;

providing, by the first node, one or more elements into the data structure, the provided one or more elements indicating one or more signal processing capabilities of the first node; and

transmitting, by the first node to a third node, the data structure containing the elements indicating signal processing capabilities of the first and second nodes.

2. The method of claim 1, further comprising determining, by the first node, whether or not to activate a signal processing capability in the first node based at least in part on the received data structure.

3. The method of claim 2, wherein determining whether or not to activate the signal processing capability is further based on predefined rules pertaining to activation of the signal processing capability.

4. The method of claim 1, further comprising receiving, at the first node, a second data structure from the third node containing one or more elements indicating one or more signal processing capabilities of the third node.

5. The method of claim 4, further comprising:

providing, by the first node, one or more elements into the second data structure, the one or more elements provided into the second data structure indicating one or more signal processing capabilities of the first node; and

transmitting, by the first node to the second node, the second data structure containing the elements indicating signal processing capabilities of the first and third nodes.

6. The method of claim 5, further comprising determining, by the first node, whether or not to activate a signal processing capability in the first node based on the received data structures.

7. The method of claim 6, wherein determining whether or not to activate the signal processing capability is further based on predefined rules pertaining to activation of the signal processing capability.

8. The method of claim 1, wherein receiving the data structure at the first node comprises receiving the data structure at a media gateway.

9. The method of claim 1, wherein receiving the data structure at the first node comprises receiving the data structure at a base station.

10. The method of claim 9, wherein receiving the data structure at the base station comprises receiving the data structure at the base station from a mobile station.

11. An article comprising at least one storage medium containing instructions that when executed cause an entity to:

communicate data structures each containing one or more elements indicating one or more signal processing capabilities of a first node and a second node coupled to the entity.

12. The article of claim 11, wherein communicating the data structures comprises:

receiving, at the entity, a data structure containing one or more elements indicating one or more signal processing capabilities of the first node;

adding, by the entity, one or more elements to the data structure, the added one or more elements indicating one or more signal processing capabilities of the entity; and

transmitting, by the entity to the second node, the data structure containing the elements indicating signal processing capabilities of the first node and the entity.

13. The article of claim 12, wherein communicating the data structures further comprises:

receiving, at the entity, a second data structure from the second node containing one or more elements indicating one or more signal processing capabilities of the second node.

14. The article of claim 13, wherein communicating the data structures further comprises:

adding, by the entity, one or more elements into the second data structure to indicate one or more signal processing capabilities of the entity; and

transmitting, by the entity, the second data structure containing elements indicating signal processing capabilities of the second node and the entity.

15. A system comprising:

means for communicating with first and second nodes; and

means for receiving a data structure containing one or more elements indicating one or more signal processing capabilities of the first node; and

means for transmitting to the second node the data structure containing elements indicating signal processing capabilities of the system and the first node.

16. A method comprising:

communicating, from a first node, signal processing capabilities of the first node to another node.

17. A method comprising:

identifying, in a first node, signal processing capabilities of a second node.

18. A method comprising:

receiving, in a first node, signal processing capabilities of a second node; and

resolving, in the first node, conflicts and adverse interactions of signal processing capabilities of the first node with signal processing capabilities of the second node.